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Industry Studies 2003**

Construction

ABSTRACT: The economic recession finally caught up with the construction industry. Public works, institutional building, and housing are insufficient to maintain industry momentum in 2003. Overall value remains strong but there are few growth markets domestically or internationally. Two growth niches are military privatization initiatives and security enhancements. While devoting more resources to information technology, full realization of the benefits still exceed industry's grasp. Industry must partner with other stakeholders to fix the shortage of labor in the skill trades. Research funding remains low compared to other sectors. Despite these challenges there are no serious concerns about the ability of the industry to continue to support future national security objectives.

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PLACES VISITED

Domestic

Associated General Contractors of America, Alexandria, VA
Massachusetts Turnpike Authority, Boston, MA
American Subcontractors Association, Alexandria, VA
National Energy Management Institute, Alexandria, VA
National Association of Homebuilders, Washington, D.C.
San Francisco District HQ, U.S. Army Corps of Engineers, San Francisco, CA
Fluor Corporation, Aliso Viejo, CA
DPR Construction, Redwood City, CA
Metropolitan Transportation Authority, Los Angeles, CA
The United States Capitol Visitor Center Project, Washington D.C.
General Services Administration, Washington, D.C.
Bechtel Inc, San Francisco, CA
Boston Harbor/Central Artery Tunnel Project, MTA, Boston, MA
California DoT, Airport Bay Area Rapid Transit Extension, San Francisco, CA
American Society of Civil Engineers, Washington D.C.
Parsons-Brinkerhoff, New York, NY
Pentagon Renovation Project, Arlington, VA
Port Authority of New York/New Jersey Headquarters, New York, NY
Ralph Parsons Inc, Pasadena, CA
Sheet Metal Workers Union, Local 100, Suitland, MD
Stromberg Sheet Metal Works, Beltsville, MD
The Port of Oakland, Oakland, CA
Design-Build Institute of America, Washington D.C.
Golden Gate Bridge Highway and Transportation District, San Francisco, CA
Virginia DoT, Springfield Interchange Project, Springfield, VA

International

South Korea:
U.S. Embassy, Seoul
Bechtel International (Korea High Speed Rail Project)
Hanmi-Parsons Corporation
Incheon International Airport
Morgan Stanley Real Estate Fund (Sang-do Urban Development Project)
United Nations Joint Security Area, Camp Bonifas, (DMZ and Tunnel 3)

Thailand:
U.S. Embassy, Bangkok
American Chamber of Commerce
New Bangkok International Airport
Rama VIII Suspension Bridge
Siam Paragon Development Company

Metropolitan Rapid Transit Authority of Thailand
Underground Mass Transit System (Subway in Bangkok)

Japan:
Shimizu Corporation HQ
Nihonbashi 1-Chrome Project/Merrill Lynch
Kajima Corporation HQ and Technical Research Institute
CENTRAIR (Central Japan International Airport)



JCAF

INTRODUCTION

The construction industry builds the public and private infrastructure that provides the foundation for our economic and military elements of national power. The construction industry study seminar completed a broad-based review of this vital industry through a series of guest lectures, intensive studies, and domestic and international site visits. A broad spectrum of this diverse industry was covered by engaging with representatives of the global top 10 construction companies, general contractors, trade unions, professional associations, research institutions, U.S. and foreign government agencies, industry lobbyists, and customers. Site visits provided first-hand exposure to the challenges associated with the design and construction of modern bridge, tunnel, subway, airport, and port mega-projects and the competitive conditions of both the domestic and international marketplace. This assessment of the current status of the industry is largely based on those visits and discussions. Individual essays focus on rebalancing the skilled labor market, information technology, and guidelines for profitability in military housing privatization projects. While not without its challenges, the construction industry remains well positioned to continue to support our national security objectives.

THE INDUSTRY DEFINED

Structure. The construction industry is a vital component of the U.S. economy employing 7.9 million workers and accounting for 8% of the gross domestic product.¹ Once you get below the oligopoly held by a few giant general contractors, the construction market primarily operates under very competitive market conditions of: numerous small firms and customers, homogeneity of product, and freedom of entry and exit. Construction is a highly competitive industry where reputation means a great deal and industry-leading firms ensure that customers are satisfied. Some participants do exceptionally well and have built long-term histories within the industry. Others are forced to enter and exit with the ups and downs of the business cycle, though the cost of entry is going up.

The industry is segmented into three sub sectors: (1) building construction, land subdivision and land development, (2) heavy construction (other than buildings), such as highways, power plants, and pipelines; and (3) construction activity by special trade contractors. Over 700,000 contractors or establishments², form a near perfect competitive market engaging in a wide range of activities including new construction, alterations, reconstruction, installation, maintenance, repairs, demolition or wrecking of buildings and other structures, clearing of building sites, sale of materials from demolished structures, performing blasting, test drilling, landfill, leveling, earthmoving, excavating, land drainage, and other land preparation, to design and construction management. The special trade contractors account for about 63% of all the firms within the industry while the general construction and heavy construction represent respectively 31% and 6%. However, with regard to sales, receipts or shipments, the general contracting sub sector produces larger earnings than the other two segments of the construction industry³. With an annual payroll of about \$175B dollars, the total sales, receipts and shipments by the construction industry reached \$815B dollars in 2002⁴.

Trends. The number of construction establishments showed an overall growth from 1970 to 2001. While the number of heavy construction contractors has been steady throughout the years, the special trade contractors division jumped from 214,275 to 442,630 contractors representing an average increase of 206%. The number of employees in the special trade contractor sub sector more than doubled during the same period (1,396,000 to 3,441,500 employees). In comparison, the building, development and general contracting sector experienced some ups and downs while increasing from 90,576 to 216,355 establishments. General contracting employment experienced some fluctuations during this same time period while heavy construction maintained a uniform progression with increases of 588,953 and 135,400 employees respectively.

Research and Development. The two primary facilities used by the DoD to conduct research and development to meet the diverse missions assigned to military construction are the US Army Construction Engineering Research Laboratory (CERL) in Champaign, Illinois⁵; and the Naval Facilities Engineering Service Center (NFESC) in Port Hueneme, California.⁶ The five primary research organizations focused on civil infrastructure outside of the Department of Defense are: the National Science Foundation (NSF),⁷ the National Institute for Standards and Technology (NIST), Construction Industry Institute (CII), Civil Engineering Research Foundation (CERF) and the American Society of Civil Engineers (ASCE).

CURRENT CONDITIONS

Domestic Performance. The total domestic construction industry is experiencing a period of flat growth while maintaining a historically high contract volume. In 2002, public works, institutional buildings and housing all posted impressive growth rates which offset the huge declines in the industrial commercial and office building markets. Educational construction grew 13%, conservation and development 10%, and sewer systems 7%. Highway and street construction was up by 0.5% from 2001 to 2002. The housing market has grown an average 7.8% for the past four years. The institutional building markets averaged annual increases of 8.3% over the last four years, while several key nonresidential building markets were hit hard in 2002. Hotel and commercial building markets experienced double digit declines in 2002 and the office building market declined 21%. The industrial market fell 26% in 2002, the fifth consecutive year of decline, 54% below 1997. The \$11 billion utility market declined 39% in 2002. Two bright spots in the industry are in apartment building and hospital construction, which grew 17%.⁸ The big players in the industry have not changed. Bechtel, Fluor, Skanska, Centex, Jacobs, Turner and Parsons continue to lead the industry, accounting for approximately \$35 billion in total domestic revenue.⁹

International Performance. U.S. corporations accounted for nine of the top 50 international contractors.¹⁰ The 2002 international construction market provided worse returns than experienced at home. The nation's top contractors reported \$19.6 billion in revenue from projects outside the U.S., down 10.9% from \$22 billion in 2001.¹¹ One of the driving reasons for the downturn was financial volatility in international petroleum

and industrial process work. Those sectors accounted for \$19.1 billion in 1999, but only \$11.4 billion in 2002. Consolidations in big oil companies, global turmoil, and uncertainty in oil prices negatively impacted projects. The electrical power market was also slow, but some corporations are seeing new opportunities for power plants in Asia and Europe. While Eastern Europe is an emerging market, funding problems are hampering construction and development.¹²

LOGCAP. In December, 2001, the Army Operations Support Command, a major subordinate command of the Army Materiel Command, awarded the Army Logistics Civil Augmentation Program (LOGCAP) III contract to Halliburton Kellogg Brown & Root (KBR) Government Operations division. Halliburton KBR formerly was known as Brown & Root Services. LOGCAP III is a 10-year task-order contract with a 1-year base period and nine 1-year options.¹³ By working with the Army planners, Halliburton KBR will provide for the construction of base camps and their infrastructures, including billeting and dining facilities, food preparation, potable water, sanitation systems, showers, laundries, transportation, utilities, warehouses, and other logistics support. Also included is support of the reception, staging, onward movement, and integration process for U.S. forces as they enter or depart theaters of operations by sea, air, or rail.

The most recent effort on the LOGCAP contract is for work in Iraq. The Corps of Engineers put in place a "bridge" contract with Brown & Root, which is being used for an interim period as a bridge to competition. The contract with Brown & Root is an Indefinite Delivery/Indefinite Quantity (ID/IQ) contract that enables the government to immediately obtain, through the placement of task orders, the specific services it needs to execute contingency plans. As of May 6, 2003, five orders have been placed totaling \$76.8 million.¹⁴

Housing Privatization. The General Accounting Office (GAO) recently found that the DoD's overall housing privatization program¹⁵ had achieved its two key financial goals - leveraging government dollars for commercial loans and lowering life-cycle costs of operating and maintaining housing. In its report the GAO concluded, "Although implementation of the privatization program started slowly, DoD has picked up the pace and plans to use the program as the primary means to meet a revised goal of eliminating inadequate military housing by 2007, instead of the original goal of 2010" (GAO-02-624). The GAO made several suggestions for improving the management of the program including developing a single consistent way to:

- analyze whether housing is needed on bases or whether there is enough affordable housing in surrounding communities,
- determine whether proposed increases in military housing allowances will allow more military families to live off base, and
- write provisions into contracts that minimize developer profits from increases in housing allowances.

Defense officials are studying each of those issues. DoD is seeking \$4.2 billion in fiscal 2003 to continue upgrading military housing.

Utilities Privatization. The Defense Reform Initiative Directives (DRID) #9 and #49 directed the privatization of electric, water, wastewater and natural gas systems, except where uneconomical or for unique security reasons.¹⁶ DoD made limited progress in its privatization efforts during the past year. As of 4th Quarter 2003, the Services identified approximately 1,524 systems as being available for privatization, solicited bids for 857 (56%) systems through requests for proposals, privatized 38 (2%) systems, exempted, placed on-hold, or temporarily deferred 477 (32%) systems, and have 152 (10%) systems pending request for proposal release.¹⁷ These numbers represent nominal increases of nine privatized systems and eight RFP releases since 1st Quarter 2002.¹⁸

Security Impact. A niche market quickly sprung up as result of the tragic world events resulting from terrorism, creating an overnight national concern with security. Though rumors about huge outlays of federal capital to support infrastructure enhancements and fortifications in the wake of September 11 never materialized, many firms are jumping on new opportunities in the security arena. One focus gaining momentum is “vulnerability assessments” of water systems, dams, power plants and chemical plants, with the term “hardening” added to companies’ lists of services offered.¹⁹ Because the security niche in America is growing so quickly, partnerships offering specialized services evolved uniting expertise and capabilities from several different companies.²⁰ Many firms believe the security market niche is here to stay, and likely to evolve over the next several years. As CH2M Hill’s Bill Wallace exclaims, “We have to look at things holistically, not just from a security standpoint. How big the market will be is the wrong question. Over time, this will change the way we do infrastructure.”²¹

Embassy Construction. Embassy construction continues to be a growth area. The recent trend in embassy construction contracts is towards Design-Build, versus the traditional method of Design-Bid-Build. The State Department’s Overseas Building Operations (OBO) office saved \$70 million last fiscal year by implementing best business practices.²²

Research and Development. In general, private construction firms have not fully supported new construction technologies nor encouraged research and development of new technologies. The conservative nature of the industry, liability concerns, reliance on prescriptive codes and standards, and first cost versus life cycle cost mentality have limited investment in research and development and therefore the advancement of state of the art practices. The Federal government plays a major role, accounting for nearly two-thirds of a \$3.5 billion annual R&D effort.²³ The largest construction firms in the United States typically spend less than 1% of their total revenue on research and development.²⁴ In contrast, the major private contractors in Japan often fund their own extensive in-house research and development institutes.²⁵

Environmental. The construction industry, like all profit-oriented industries, must walk a fine line between the need for environmental reforms and regulations, and environmental efforts that impede economic growth. Unlike the federal government’s BRAC program, the private sector sometimes simply leaves a contaminated piece of land vacant instead of cleaning it up. When profit is the primary motivating factor, leaving a

dirty site untouched can be the best solution for the balance sheet. But this practice doesn't bode well for the industry as a whole. Not only is a piece of land unavailable for productive use, but public frustration also gives construction firms a bad reputation.

Delivery Methods. After years of spectacular gains, design build revenue flattened out in 2001. Legislative breakthroughs are aiding the public sector, like Arizona's alternative project delivery and Minnesota's legislation encouraging design build for state projects. Construction management as a delivery process is declining, as owners shift greater amounts of risk to their contractors. Construction management at risk has maintained steady growth since 1999. It is an alternative project delivery method when it is difficult for a public project to be accomplished by design build. Using construction management at-risk, the owner becomes an integral part of the construction process, and leverages all three interested parties.

Military Construction. Terrorism significantly impacted military construction tasks by presenting difficult financial constraints and creating an uncertain environment for maintaining the readiness of U.S. facilities. Military construction remains under funded. Going forward, new facilities must last longer, be more efficient, be under budget and on time, and accentuate the military mission while devoting greater attention to being environmental consequences. Since the Department of Defense manages and maintains the largest dedicated infrastructure in the world, most of the military construction projects focus on base support and family housing projects.

MAJOR CHALLENGES

Labor force. While the demand for a ready, willing, and able work force is a constant over time and across industry sectors, the construction industry is facing unique challenges, not only in resourcing current needs, but also, in its' ability to grow a pool of skilled and productive labor to meet future requirements.²⁶ Soliciting and preparing young men and women for a career in construction, and retaining those already in the workforce, will require a per capita investment both greater and more diverse in scope than any previously seen within the construction industry. While the industry itself must take the lead in addressing the problem, government support will be needed to help leverage the generation and retention of a work force to support both current and future needs. This topic is the subject of further discussion in a later essay.

Embassy Security. The increased threat of global terrorism had an unprecedented impact on U.S. overseas construction. Embassies are being modernized and constructed at an unprecedented rate, and many U.S. owned and/or operated facilities overseas are looking to upgrade their capabilities. The new embassies opened in Nairobi, Kenya and Dar es Salaam, Tanzania are model installations. Both have 3 ½ inch thick bulletproof windows and walls able to withstand a blast from a 1,000-pound bomb, are set back more than 100 feet from the road, and the buildings have six-foot-thick concrete walls with reinforced steel doors that resemble freezer lockers.²⁷ New construction is typically built on a 10–15 acre compound or “campus”. When all the protective measures are implemented concurrently, the embassies of the future will prove to be a much safer,

secure environment for American citizens working abroad. New embassy compounds will now be completed within two years after breaking ground. At this projected rate the State Department is well on the way to completing the 180 compounds scheduled to be constructed within the next ten years. The challenge the U.S. faces is not lack of dollars, but lack of time, finding a skilled work force, and reassessing the threat to determine if the same size personnel presence is necessary overseas.

Codes. Building codes exist to provide a minimum standard for the health and safety of the public at the lowest acceptable cost. The construction industry does not have a national building code for the United States. States decide which codes they adopt, use and enforce; codes can change from state to state, and/or local jurisdiction to local jurisdiction. Sometimes climatic conditions and demographics of the buyer necessitate the difference, but often codes change from jurisdiction to jurisdiction for no apparent reason. Construction firms must recognize and adhere to the particular set of codes used in their local area. The result is non-standard material supply operations, slower project completion times, confusion in building code enforcement, and possibly unnecessary and expensive additions/alterations to projects. The Government needs to work with industry to develop a national building code and thereby improve construction efficiency, affordability, and profitability.

Privatizing DoD Utilities. In general, infrastructure privatization projects ask private investors to accept major risks that require many years to recover costs. The unique character of the projects requires non-recoverable capital investment into systems that may not be used elsewhere. They also require investors to act as a monopoly for services where the DoD is essentially the only customer.²⁸ Effective policies entice investors to carefully select the projects they will pursue and to efficiently run those projects they win.²⁹ Therefore, the government must be reasonable about the amount of risk it asks investors to take. Until now, however, attempts to transfer too much risk reduced incentives for potential bidders to pursue contracts and impacted contractor interest.

Some of the emerging issues are: system purchase values; wage issues; property and state/local taxes; request for proposal consistency and continuity issues; DoD-wide schedules and response time frames; delayed government decisions, system inventories and associated risks on bidders; easement issues; project bundling, and a need for government feedback.³⁰ Foremost in utility industry leader minds is the need for clear policies, level playing fields, aggressive award timeline compression and improved communications.

A quick summary of contractor concerns highlights the challenges DoD needs to overcome to move the privatization process forward:

- a. Incremental estimates fail to consider overall engineering and management costs.
- b. Utilities can only privatize gas and electric systems that meet state codes, yet many government estimators do not develop costs based upon approved utility codes.³¹
- c. Contractors should be exempt from Contribution in Aid of Construction taxes if the system will be used solely to service the government.

- d. The Service Contract Act is a real problem for local utilities as it drives different on and off-base wage sets for the existing workforce.
- e. Allowances for catastrophic insurance should be allowed as a pass-through charge.
- f. The government should standardize the basic elements of privatization solicitations.
- g. Time allowances for submissions are too short. There is no bid timing coordination among the Services³² and contractors do not have time to develop complex proposals.
- h. Offerers are frustrated because of extended award decision times lasting as long as 1-2 years. Some contractors receive no feedback for those extensions.
- i. Some solicitations put the offeror completely at risk if actual inventories differ from solicitations. The practice puts a large burden of effort, time, and cost on contractors.
- j. A more onerous issue is mandatory bundling of systems or installations. Offerors have watched the government make numerous changes to solicitations that bundled, then unbundled, then re-bundled projects again. The provision to bundle projects according to locations serviced by existing municipalities is suspicious to potential offerors as it appears to be tailoring the packages for target suppliers.

In short, contractor frustration is dampening their desire to continue pursuing utility privatization efforts. Response timelines must be set to within three months for initial proposals reviews with the entire process completed within a year.³³ Anything more, discredits the program and drives a wedge between the government and prospective utility contractors. The DoD must find ways to resolve open issues quickly and keep initiatives moving forward.

OUTLOOK

Short Term. The U.S. construction industry's economic forecast for 2003 is not as promising as in prior years. The power of institutional building markets, which averaged annual increases of 8.3% over the last four years, will rise just 1% next year, to \$93.8 billion. Likewise, the value of contract awards for new single-family housing will show no growth after averaging a 7.8% annual growth rate since 1999. Compounding this slowdown are further declines in several key nonresidential building markets. The office building market will decline another 3% and hotel and commercial building markets are not expected to rebound until after next year.³⁴ Even with a predicted 6% increase in industrial work, that market sector will still be 54% below 1997.³⁵ The two brightest spots in the short-term forecast are a 7.4% increase in apartment building construction and a 2.9% hike in hospital work. Schools and highways are holding at historically high levels.³⁶

Public construction has the most uncertain outlook. Many contractors are still busy with projects approved years ago, when states had plenty of tax and bond receipts, but their order books are empty. Bond issues generally fared well last November; most of

that money will help keep K-12 school construction healthy. But general-fund financing continues to shrink in nearly every state, making the outlook shaky for most categories of public construction. As President Bush continues to emphasize defense and domestic security, his latest budget request for 2004 would trim many construction programs to help keep the growing deficit from getting larger. The few winners include State Dept. embassy security and the General Services Administration's renovations account.³⁷

As for residential construction, several factors will keep single-family construction strong in 2003, although it will be hard to improve on last year's numbers. Mortgage rates should stay low, if not quite at the 40-year low of 5.6% that prevailed in late March 2003. Personal income will continue rising fast enough to outpace inflation, giving people the wherewithal to buy homes. Freddie Mac and Fannie Mae have raised the limit on mortgages they finance by 7%, to \$322,700. These factors will keep resale levels healthy as well.³⁸

Long Term. The long-term future of the nation's construction industry appears to be healthy. The United States will continue to be one of the leading construction markets in the world, employing approximately 8 million people and accounting for nearly 8% of the American gross domestic product. Although the percentage growth may vary from year to year, overall volume of construction put in place will remain high. Weak sectors of the industry at a particular time, such as the office building market, which is currently slumping, will be offset by stronger sectors, such as the residential market. American construction companies will continue to be successful competitors in the global market, although most of the actual overseas construction will continue to be done by foreign sub-contractors using local labor. The industry will have to face challenges in foreign competition, the diminishing supply of domestic skilled laborers and the increasing cost of insurance.

The construction industry has always contracted and expanded based upon demand. This linkage will remain true, as construction in general is not closely tied to advances in technology. On the other hand, construction contracts will always depend on what happens in the overall economy, which also reflects what happens in the world. Construction related to domestic housing and other types of domestic consumer activity should continue to remain strong, but business-related construction will not pick up until there is more certainty about the world situation. This is also true for government spending that is not security-related. Increasing federal government spending for public works, such as highways, will not offset state and lower government spending reductions due to increasing budget deficits. Education related construction should increase with the increasing demand for K-12 facilities. Continued low interest rates will be a major factor in continued domestic housing activity. However, the aging of America may change this construction demand with a focus on retirement communities and facilities at the expense of single-family housing. The victory in Iraq will provide significant opportunities for government-funded construction, although the continuing uncertain world situation, particularly with the war on terrorism, will continue to reduce global markets. Many global construction consumers will elect to wait and see, hoping for a better environment or at least a better picture, before electing to construct.

Global Marketplace. Overseas opportunities for U.S. construction companies are growing, but revenues have steadily decreased in the past couple of years. In 1999, the Top 400 contractors earned international revenues at an all-time high of \$29.63 billion. In 2000, revenue sank to \$25.45 billion, and in 2001, it sank again to \$22.03 billion. This 25.6 percent drop in two years is attributed to a slow economic recovery in the Far East Asia theater.³⁹ The outcome of U.S. involvement in Iraq will likely precipitate enormous construction requirements in the Middle East, but security is a foremost concern for American companies as “private sector companies just don’t have the resources to protect their people overseas.”⁴⁰

The European market continues to be a major focus for U.S. construction firms. The biggest projects are railroad upgrades, with major endeavors in England, Ireland, the Czech Republic, and in Holland. “The European market is improving gradually, but we have grown rapidly through acquisitions,” says Tom Hammond of Jacobs, who gained a valuable customer base in The Netherlands, Belgium, and Germany, through its acquisition of the Dutch firm Stork NV, and in the U.K. through the former LawGIBB Group of Atlanta, which held interests there.⁴¹

Design-build seems to be a recurrent theme. “In water and wastewater, international opportunities for design-build are ‘huge,’” says Earth Tech’s president, Diane C. Creel. “Mexico is a great market for us. We have four design-build projects on the boards in Ireland. There are design-build finance-operate projects under way in China, and we look at Eastern Europe to provide some of the largest opportunities anywhere.”⁴² With China’s entry into the World Trade Organization, it may become one of the brightest prospects for American diversification into foreign markets. Currently, the largest overseas project for an American firm is Bechtel’s \$4B dollar Nanhui Petrochemical Complex in Guangdong Province, southern China. The energy/petroleum/ chemical (EPC) industry there may be the biggest opportunity for U.S. contractors in years.⁴³

American firms are seeking international markets to bolster revenues, but they’re not alone—they face stiff competition. Only innovative and flexible construction firms with carefully applied strategies and stout financing can ply these markets to gain a larger share in the equally complex and dynamic global economy. U.S. government assistance should not and cannot be relied upon even when their challengers—foreign competition—are being subsidized.⁴⁴ “We don’t bid the jobs overseas where there are slim profit margins and risky clients. Overseas firms are usually able to take these on, and they’re subsidized, so they can take more risk” according to a high ranking official of a large domestic firm.⁴⁵

GOVERNMENT GOALS AND ROLES

Research and Development. DoD should continue a strong coordinated research and development program that enhances the capabilities of military construction units. For DoD to continue to construct facilities that are secure, built to last, and are completed on time and within budget, the research laboratories need to keep their focus on emerging

developments in construction. The budgetary investment applied to military construction could yield huge dividends in the future through modernization provided by the strong application of research products. Military construction will continually lessen the negative impact on the environment, because the structures and facilities built today will be used for long periods of time in the future. Military construction will continually serve the national strategy by staying current with research and development and leveraging technology today to build structures and facilities relevant tomorrow.

Interdisciplinary research is needed to integrate different perspectives, combining engineering with the needs of users and communities, while removing boundaries that conventional research has typically not crossed. Integration inevitably involves bringing together the views of many different types of organizations from academia, government, industry and the nonprofit sectors. While organizations like CERF and CII facilitate, coordinate, and integrate applied research and innovation for infrastructure as independent not-for-profit organizations, they lack funding to make a significant impact. There needs to be an International Construction Research Information Clearinghouse to catalog all civil infrastructure research world-wide and is free to query. The center must have a research staff and publication arm to serve as a central repository for R & D efforts in the field. Similar clearinghouses exist within specific fields in education. Having clearinghouses will help eliminate research redundancy and provide a portal (a one stop shop) for the latest research in a given construction field.

Tariff on Canadian Lumber. The disagreement between Canada and the United States revolves principally around the stumpage fees Canadian provinces charge timber companies for logging on government lands. The U.S. forest products industry contends the fees are set extremely low, giving Canadians an unfair competitive advantage and that Canadian mills are dumping “below-cost” lumber into the United States. Canadian producers deny accusations of unfair subsidies. In theory, tariffs were supposed to give the U.S. lumber industry a competitive advantage by raising prices, which in turn would cut the demand for Canadian lumbers. Instead, they negatively impacted the marketplace and harmed housing affordability by creating huge volatility in lumber prices.

The present tariffs are counterproductive and should be eliminated. Because of the limited U.S. domestic timber supply, Canadian lumber imports are essential for the construction of affordable new homes and improvements on existing houses in the U.S. Canadian lumber should be shipped into the United States duty-free in accordance with the parameters included under the North Atlantic Free Trade Agreement (NAFTA).⁴⁶ In turn, the US lumber industry needs to continue to review restructuring options in order to improve its competitiveness.⁴⁷

ESSAYS

Essay #1 – Rebalancing the Skilled Labor Supply in the Skilled Trades

Today, the construction industry lacks the workers needed to meet both current and future demand, especially in the skilled trades. The effect is an increase in cost and a decrease in the quality of construction output. While construction industry stakeholders

continue to express a need for a robust workforce, the focus of attention is shifting to include even greater concern about the sources of future work. This shift in focus, back and forth, from workforce to work, is not a new phenomenon. However, given today's environment, it may behoove all stakeholders to keep workforce generation and productivity enhancements squarely in the line of sight. Though few would argue that a larger pool of workers is of little consequence if there is no work, it is important to understand there are emerging issues, in the generation and retention of an effective workforce, that will create special challenges and, most certainly, will require more lead-time and ingenuity to mitigate than in the past. While investing additional dollars in marketing tools to improve the image of the construction industry and to expand the recruiting reach and base to include women and minorities is commendable, it is only a very small piece of what is required to garner a long term fix for the labor shortage in the construction trades.

Construction work is physically demanding as well as dangerous. This fact is not lost on the new generation of workers who place high value on physical comfort. The image of the construction worker and the construction site is jarring for those who have grown up in the dot.com world. And, while workers today demand more flexibility in work arrangements, flexibility is not known to be a hallmark of the construction industry. In addition to more user-friendly work environments, workers demand a living wage that affords them access to a quality lifestyle. The problem is construction wages, salaries, and overall compensation, continue to fall relative to other industries and the labor force continues to move away from the skilled trades. Worker productivity continues to decline and profitability is negatively impacted.

In order to remain competitive, contractors require a critical mass of employees with specialized skills. Acquiring the high marginal revenue product⁴⁸ employers are looking for in a qualified carpenter, electrician, or sheet metal worker takes years of classroom and on-the-job-training (OJT). Unfortunately the traditional training system has lost its market dominance and no new system has arisen to fill the void.

For an earlier generation of American youth the path to skills training and a place in the primary labor market was straightforward- graduate from high school and join a union. The union provided a multi-year apprenticeship program that combined classroom instruction and OJT to produce a set of skills tailored for the specific industry. The apprentice immediately earned above minimum wage and after 3-5 years reached skill and pay parity with his fellow journeyman. As a journeyman, a small portion of his/her union dues were committed to continue supporting the training system. Through collective bargaining, the union assumed the training burden and costs from the contractor in exchange for higher wages. Refresher training and night classes were also available enabling the workforce to keep abreast of technology.

The whole system worked well while the unions represented a majority of the skilled labor supply. However, the union's monopoly of skilled labor has steadily eroded since the 1960s. In 2002, the representation of union labor in the U.S. construction industry fell to 19%. The reasons for the decline are varied and complex but major elements

include the Taft-Hartley Act of 1947 that shifted power back to management, “non-economic” collective bargaining agreements, changing demographics, and the overall transformation from an industrial to an information age economy. With the monopoly broken, the near perfect competitive market forces of the construction industry now drive the labor supply and demand relationship. So why does a perfectly competitive marketplace produce a labor shortage instead of the theoretical efficient allocation of resources?

Externalities cause the marketplace to misallocate resources. An externality is defined as an economic activity that causes incidental benefits or detriments to others not directly involved in the activity without proper compensation to the provider. Externalities are failures to price resources so the market can allocate them efficiently. Leaving those costs and benefits outside of the profit calculation breaks down the argument that the lowest possible price produces the best allocation of resources. The training costs are left out of the calculation for the non-union labor that increasingly dominates the construction job site. Training has become an externality in the construction marketplace. A training system provides a beneficial externality to the community by providing better workers to future employers. However, the cost of OJT becomes a detrimental externality to the current employer when a skilled employee leaves the company. A private contractor cannot afford to absorb the training costs when the primary competitive mechanism is contract award to the lowest bidder, union labor is not required, and numerous competitors and homogenous products allow skilled workers high job mobility. Those market forces encourage successful special trade contractors to push the cost and burden of training onto someone else – the individual worker.

The social and financial barriers to obtaining and maintaining the required skills are too high for the shrinking non-college bound labor pool. Plus there is no real substitute for OJT in the skilled trades. The result is an insufficient level of skilled workers entering the labor force and degradation in the quality of those who do overcome the other training barriers. When combined with an aging workforce and a rising demand, the impact is a serious supply problem. The solution to the skilled labor resource allocation problem in the construction trades is to put the training externality back into the contractor’s profit equation. Since the market cannot properly account for externalities, the government must take the necessary action. The best means at the government’s disposal is a change in fiscal policy to account for the training externality through taxes and subsidies (tax credits). With training costs and benefits properly accounted for the market will properly balance skilled labor supply and demand. The key to success is to fairly implement the new policy and avoid the vagaries of excessive central planning.

Training tax credits must be available equally for all forms of skill acquisition while the selection of the training mechanism remains with the consumer. In this case, the consumer is either the contractor or the individual worker. Contractors who provide OJT will be given subsidies to cover the difference between their marginal social costs and marginal private costs. The contractor is free to choose how the training is provided. They can do it in house, partner with a local vocational school, or hire union labor thereby in effect “sub-contracting” with a union to provide the skill training through their

existing apprenticeship program in exchange for higher wages. Contractors will not be required to provide training for their workers. However, that choice will come with an appropriate price tag. If a contractor decides not to support a training system, they will be taxed at the local area average of the difference between the marginal social costs and marginal private costs of other contractors who do provide worker training. The taxes will be used to offset the federal revenue loss from training tax credits. Individuals who choose to obtain their own training will receive a comparable tax credit on their individual income tax returns. The net effect of this fiscal policy is to enable the creation of a market driven training system that maximizes the efficiency of balancing the supply and demand curve for skilled workers.

An engine of the American economy is in danger of becoming derailed. The near perfect competitive marketplace of the construction industry special trades segment is flawed by a training externality. The proposed fiscal policy changes will put the training costs and benefits back into the contractor's profit equation thereby allowing the free market to rebalance the skilled worker supply and demand curve and keep the construction industry, and therefore the overall economy, on track.

(Kathy Collier, Rita Meyer, Michael Leahy)

Essay #2 – Information Technology and the U.S. Construction Industry IT

The world today is focused on knowledge as a key resource and on information technology (IT) as the way to enable it. Industry has recognized this trend and is moving toward implementation of IT in its business processes. The construction industry is also becoming more involved in the use of IT. Accounting systems, office automation, and word processing were the first, and most common IT applications in construction. Email and web-based information sharing have become increasingly essential. IT was applied by individual companies to achieve efficiencies and short-term gains, or for cost savings. Computer Aided Design (CAD) is increasingly more important as a productivity aid. Order processing, inventory/supply management, evaluation software, project-planning systems, and other such individual technologies were implemented over the years, but it is not an industry wide capability.

IT in construction encompasses such sophisticated capabilities as virtual-reality, knowledge-based systems, object oriented approaches and neural networks. Though knowledge-based applications are used for design, engineering, management and economics in construction, indications are there was not enough thought given to its application for business and management.⁴⁹ Another advance in IT benefiting construction contractors is the use of e-business. Companies have started to manage their supply chain, much like the automotive and aeronautical industries before them. Today, the larger companies improve their performance in the acquisition of materials, personnel, equipment and services, by using e-commerce. In addition, a number of trading websites have sprung up to afford construction buyers the option to save money by buying materials, products and services on one site. Bidding can become fierce, however, and may cause the prices to be higher than need be. A careful manager will always check the prices with local standards.

Industry Wide Absorption of Information Technology: Although it is not happening at the pace one might expect, use of IT is continuing to increase throughout the construction industry. In visits to several of the big construction firms (i.e. – Bechtel, DPR, Parsons, and Fluor), it was clear the larger firms are currently using IT in a number of different ways and the use of IT is expanding. One firm has a Chief Information Officer (CIO) and is pursuing IT capabilities such as the use of websites for information sharing, computerized trend analysis, and even for gaining intelligence on their competitors. They are also beginning to use online bids for supplies and materials to achieve substantial procurement savings. Another company uses a web based collaboration tool for its projects to share information, manage schedules, and reduce risk by increased understanding of all the various facets of the project. One firm has a CIO and a healthy strategic IT plan. In fact, they spent over \$14M last year for IT standardization among all of their various divisions and subsidiaries. In addition they also have a Knowledge Center with lessons learned and information matrices available to all elements of the company. All of the companies mentioned use 3D CAD for design work. This is clearly the way of the future for construction design.

For smaller sub-contractors⁵⁰, using IT is still somewhat new and usage is expanding. But a small company designer expressed frustration with the way IT is being used among some small firms and sub-contractors. His view of the problem is the various sub-contractors and subs to the general contractor have different software that won't interface with each other. Yet, if particular software is mandated for a project it will limit bidders. Many people do not know how to handle compressed files or how to share files effectively. Also, with the advent of email and other computer-based capability, people have a tendency to assume the computer is right, yet they must do a bit of extra work to ensure all of the information has been received and is correct.⁵¹

Expansion of IT in the Construction Industry: Interest in expanding use of IT in construction is increasing. A recent survey conducted by the Construction Financial Management Association states that construction contractors in the US are slowly but surely beginning to use more technology.⁵² The survey group included general contractors, specialty contractors, heavy and highway contractors and other contractors. In fact, the survey respondents reported that 88% of their office staff is now using computers and that 86% of the computers are linked to a company network. In addition, 75% of project managers have online project access and 38% of those questioned have an IT department. While this news is encouraging, it is rather surprising that such a large segment of the construction industry is still not using electronic transactions for bidding, project management, banking services and accounting.⁵³

The survey noted that few contractors (only 25%) are taking advantage of the availability of project collaboration software that allows electronic sharing, updating, tracking and archiving of project data and documents. The software (and the hardware to run it) may be cost prohibitive for the small or average sized construction firms. In addition, the use of wireless or handheld devices is not very common. Less than 10% of the companies have started using them and more than 63% have no plans to do so in the near future.⁵⁴ This is a technology that will have immediate application for construction and it's need for on site access to plans and information, yet it is not catching on. The

reasons vary from concerns with implementing required protocols, to requiring workers to learn something new, and even to concerns that job sites will be in areas where wireless access is a problem. Perhaps the biggest problem is the lack of common standards. US standards for wireless technology are not mature enough to encourage members of the construction industry to aggressively pursue it until the price drops. While the outlook is good for the construction industry to get more involved in the use of IT, the expense and lack of standards is holding back current investment.

Another survey conducted by the Associated General Contractors of America (AGC), found that online construction services are being pursued by many of its members. In fact, of over 2500 respondents, 43% said they use the Internet, 63% said they use online plan distribution, 52% use online collaboration, and 18% use the Internet for payment tracking. In addition, other Web tools such as online bidding, job site cameras and general research were cited as being used by 16% of the responders.⁵⁵ How can these results be so different from those cited previously? Perhaps the members of the AGC tend to be the larger, more progressive construction companies, which are more likely to be involved in using IT. In addition, the AGC is actively encouraging the use of IT by its members.

Summary: The Future of IT in the Construction Industry: IT has gained solid inroads into the construction industry but there is still significant opportunities for expansion. IT use will certainly continue to grow faster in some sectors than in others. Large companies with expansive budgets will continue to innovate and push the IT envelope as a way to increase efficiency and profits. Smaller companies will move more slowly into the IT world, but will have to become more and more vested in the technology to be competitive and to interact successfully with one another and with the larger firms. It will not be easy and it will be costly, but clearly IT is the way of the future for the construction industry.

(Kathy Collier)

Essay #3 – Profit/Subsidy Guidelines for USAF Housing Privatization Projects

The Military Housing Privatization Initiative (MHPI) was enacted into legislation by Congress in the 1996 National Defense Authorization Act. The Air Force has launched an aggressive MHPI campaign to privatize one-third of on base housing by 2007.⁵⁶ Privatization is only applied where the housing area can be separated from other installation functions and the economic feasibility criteria for both “scored” and life cycle costs meet DoD guidelines.⁵⁷ The first Air Force project under this new authority was completed at Lackland AFB in January 2000 and an additional 20,493 units throughout the country are in various stages of contracting over the two-year period starting in mid-2002.⁵⁸ As the campaign goes forward, one of the key issues is determining the proper profit margin and/or level of subsidies required to attract leading private firms to this new line of business.

The goal of this research was to develop a set of guidelines to help the Air Force establish a fair and equitable rate of return for their private housing partners. The primary focus was on determining a valid measure for the lifetime operating and

maintenance cost. A nationwide survey of existing condominiums and apartments provided an operating and maintenance cost baseline. Existing average utility and mortgage cost calculators provided two other key components of the housing profit equation. Comparison with Basic Allowance for Housing (BAH) rates for 22 prospective MHPI projects identified the subsidy or profit potential. The remainder of this essay provides an overview on the approach, discussion of analysis/results, and conclusions.⁵⁹

Approach. The private housing cost equation is a summation of the following components: development debt service, land rental, operation and maintenance fees, utilities, and profit over all the project's housing units and common areas. Ideally, those costs equal the sum of the BAH from all the airman occupying those units. The delta between the total BAH and costs is the required subsidy. Since the exact solution is dependent on the occupant mix⁶⁰, which is not known a priori, the objective was to determine guidelines based on major rank/grade groupings. Armed with those statistics, and the projected local population mix, housing officers can make a more informed decision about the best-value private housing provider and contract arrangement.

Existing MHPI projects are too new to provide a solid database for the housing cost equation. The closest analogy is a cross between an apartment and condominium complex.⁶¹ The definitive source of condominium operating and maintenance costs is the expense analysis on condominiums, cooperatives, and planned unit developments published yearly by the Institute of Real Estate Management (IREM).⁶² The closest unit type match is the townhouse and is therefore the basis for analysis.

To fully estimate the operation and maintenance fees for a government housing complex one must also include the indoor maintenance and repair costs that are typically not the responsibility of the condominium association. The closest analogy for this piece of the equation is the interior expenses for an apartment complex. IREM also publishes an income/expense analysis of conventional apartments.⁶³ The closest unit type match is the garden apartment. Therefore, the interior expenses for an 1800 sq ft garden unit was the basis for analysis.⁶⁴

The Home Energy Saver website provided estimates on annual energy bills.⁶⁵ The site computes energy use based on sophisticated models developed at Lawrence Berkeley National Laboratory. Based on zip code, estimates for both an average and energy efficient house are calculated with breakouts for heating, cooling, hot water, appliances, lightening and misc.⁶⁶ Average and efficient energy costs were determined for each base. The collection of average and efficient data again supports the potential mix of existing and new units.

To provide a robust set of housing cost guidelines, a representative set of Air Force bases was selected.⁶⁷ The bases were picked primarily from the list of 22 potential privatization sites over the next two years⁶⁸ with augmentation to ensure a representative span across the various condominium/apartment analysis regions. Bases representing both high and low BAH were included. The BAH rates, for both enlisted (E4, E6, E8)

and officers (O1, O3, O5), were used to obtain a representative set of potential profits/subsidies.⁶⁹

In order to complete the profit/subsidy equation for new housing projects an informed assumption was made about development costs. In four pilot projects the Air Force privatized 2,320 housing units for a total development cost of \$321.1 million dollars.⁷⁰ That translates into an average development cost of \$138,400 per unit. Mortgaged at 6% over 30 years creates a monthly development dept servicing cost of \$830. That cost is partially offset by a straight-line depreciation of \$385 leaving the true cost of capital at \$445 per month for this exercise.⁷¹

Condominium Operating and Maintenance Costs. The total median monthly townhouse condominium operating and maintenance (O&M) expense across the total US was \$145.⁷² The total expense is subdivided into individual categories of: administrative, operating, repair and maintenance, fixed, and replacement reserve.⁷³ O&M costs were highly dependent on geography ranging from \$121 (20% lower) to \$196 (25% higher) over the individual ten regions.⁷⁴ The range in condominium expenses did not track with the geographic variation in BAH. In fact the peak expenses were in the southwest and the Great Plains, two of the lowest BAH regions.

The total median monthly condominium O&M was also dependent on unit age and cost. Units over 25 years old showed a cost increase of almost 10%. This points to a similar cost increase for the old units in the existing base housing stock. The variation with unit cost was more significant. The total monthly O&M for a \$199K unit was more than 30% greater (\$158) than a under \$60K unit (\$109).⁷⁵

While the median value is a useful tool, one also needs to have a feel for the range of possible values. For condominium monthly expenses the variation in individual categories swings from 70% lower to 42% higher.⁷⁶ The net effect on total expenses for the entire US sample set is a swing of almost \$100 per month from a low of \$102 to a high of \$200. This range can be viewed as the maximum trade space a private firm can work within on this element of the profit/subsidy equation.⁷⁷

Apartment Interior Operating and Maintenance Costs. The total median monthly garden apartment O&M expense across the U.S. was \$143. The total expense is divided into three individual categories:⁷⁸ repair and maintenance⁷⁹, painting and decorating⁸⁰, and payroll.⁸¹ That expense was less dependent on geography then the condominium data ranging from \$135 (6% lower) to \$169 (15% higher) over the individual ten regions.⁸² The geographic variation in interior expenses did closely track regional variations in BAH with peak expenses in the Northeast and Hawaii.

The median monthly apartment O&M was also dependent on unit age. The interior expenses on units build before 1964 and 1977 cost an additional 15% and 32% respectively. Therefore an increase of 20% was applied when estimating the existing housing base O&M costs.⁸³ Unlike the condominium analysis, no information was available correlated to unit price.

As with the condominium data, a range of possible values was available for apartment interior expenses. The variation in individual categories swings from 40% lower to 59% higher.⁸⁴ The net effect on total interior expenses across the entire US sample set is a swing of almost \$120 per month from a low of \$89 to a high of \$211. This range can be viewed as the maximum trade space for a private firm to work within for this element of the profit/subsidy equation.

At the national level, the median condominium and apartment interior expenses are almost identical. As a general rule of thumb the total O&M costs are simply twice either individual piece. However, the regional variations are not in sync and therefore individual regional values are used for subsequent analysis. The variations due to geography are smaller for interior expenses but those costs exhibit a \$120 maximum variation between low and high values.

Utility Costs. As expected, there is a large variation in energy (utility) costs across the country. The median monthly energy cost across the entire base set for an energy efficient house was \$61 with an average of \$74 and highs and lows of \$193 and \$45 respectively. The high was at Hickam and the low at FE Warren. Other than Hickam and McGuire, there was no correlation between high energy costs and high BAH.

The cost savings for an energy efficient home are significant. The average savings across the entire base set was 41%.⁸⁵ The impact is especially pronounced for heating and cooling with greater than 50% improvement due to new technologies. The implications on privatization contracts are equally significant. The trade between contract specifications for energy efficient new construction and lower holdback of utility expenses must be carefully analyzed and addressed.⁸⁶ For this analysis, efficient costs were used for new housing projects and average costs were applied to more accurately reflect in place privatizing of the existing housing base.

Profit/Subsidies. The potential profit/subsidy was calculated for each base using the local BAH and utility data and the appropriate regional median condominium⁸⁷ and apartment O&M costs. For new housing projects the energy efficient utility costs were used. All bases used the same development dept costs as previously discussed. Given the Air Force intention to keep new housing projects within the base perimeter, no land rental costs were included. For privatization of existing housing stock the development dept costs were set to zero and the average home utility and increased O&M costs were used to more accurately reflect the aging nature of the housing.⁸⁸

There is a solid profit potential for housing privatization contractors. At the high BAH bases of Andrews, Hanscom, Hickam, and McGuire privatization is profitable even if the units are only filled by E4s and below. Every base is profitable for O5 and above and the median profit/subsidy is positive for every grade except E4 and O1.⁸⁹ Net income covers a broad spread from a maximum monthly loss of \$361 at Altus AFB to a maximum profit of \$1845 at Hanscom AFB. Across the bases an E4 BAH can produce a swing of over \$1100 per month from Altus to Hanscom. For an O5 the spread is \$1800

from a low at Whiteman AFB to again a high at Hanscom. These potential profit swings are excessive. Away from the high BAH bases the story changes.

There is a set of bases where it is difficult to foresee a contractor making sufficient profit to bid on a new development privatization contract. Given the heavy weighting of enlisted and junior officers in current base housing, it is difficult to imagine a real-world mixture of residents which produces a net positive income at Moody, Whiteman, Altus, Cannon, Little Rock, and Mountain Home AFBs. Hill, Fairchild and WPAFB are questionable. The built-in subsidy of rent-free land is insufficient. Many of those bases are in the exact rural areas where existing off base housing is sparse, i.e. exactly the places which need quality on-base housing the most.

In the case of privatizing the ownership of existing base housing, there was no base where the contractor would not be profitable with a reasonable grade mix.⁹⁰ The median net income is comparable to the 49% of gross rent achieved by the owners of garden apartments.⁹¹ In most cases there is even sufficient net income to fund a significant remodeling (\$50K per unit) of the housing stock. Even with the large increase in utility costs, the profit margins are even higher for the high BAH locations. However, the magnitude of the net income swings is essentially unchanged. Clearly the privatization contracts must be carefully tailored for each base and level of new development or remodeling.

Conclusion. The potential exists for very attractive rates of return in several regions of the country. In fact, the potential profits from certain high BAH areas are excessive. Conversely, there are numerous bases where it is difficult to envision a mixture of tenant grade levels that allow a new development project to earn a profit without additional government subsidies. There is no one contract template that covers the waterfront, but this analysis suggests two concepts for further consideration.

The following modifications to the policy of providing free land rent and the full airman's BAH as rent should be considered.

- Charge an appropriate level of land rent at existing high BAH locations. This analysis showed that except in isolated cases, the O&M and utility cost do not drive the BAH. With the cost of land rent and real estate taxes removed, the BAH is not an appropriate rent. One answer is to charge a rental fee for the base property linked to rates in the surrounding community. The land rent could be used to subsidize non-profitable bases.
- Couple the privatization contracts to pair up high and low profit bases. Allow the contractor to achieve even greater economy of scale and use the excessive profits from high BAH locations to subsidize those bases that are not profitable on their own. Depending on the specific unit sizes and locations, a single profit center could be able to support multiple other bases. Without this linkage the good contractors will just cherry pick the high BAH bids and leave the needy bases

with either shoddy service or the existing failed MILCON system. Neither of those options is acceptable.

The MIPH legislation provides the toolset needed to “fix” the Air Force housing problem. There is sufficient profit potential to attract top-flight construction and O&M firms. The key is to think of the housing requirement in a holistic manner - not base by base – and use the existing valuable base real estate to maximum competitive advantage in crafting innovative contracts. This project’s new guidelines and spreadsheets will help housing officers frame those deliberations. (*Michael Leahy*)

Essay #4 – Base Camp Construction Lessons Learned. Engineers, planners and logisticians encounter a diverse set of problems siting, planning and constructing base camps. A web site was developed by the US Army Corps of Engineers Construction Engineering Research Laboratory to identify systemic problems and potential solutions for these problems. As part of the research, students from this seminar provide entries for this web site with lessons learned based on personal experiences and extensive research conducted during the course of the project.

First, key issues, constraints and considerations were identified for numerous base camp locations from past contingency operations around the globe. Any serious environmental, material, or social issues affecting construction and operation of the camp were incorporated. Solutions developed to overcome the problem were included. The input of lessons learned was sorted along functional lines as suggested by the data, for example, Command and Control, security/force protection, environmental considerations, communication issues, logistical constraints, reception, staging, and onward movement.

This lessons learned website includes a description of each base camp used for this study, including its mission, dates of operation, number of occupants and other relevant information. If the mission and population changed significantly over the life of the base camp, that information was also included. For information on accessing the site visit <https://www.projnet.org/basecamp/>. (*Steve Austin, John Jordan, Steve Fischer*)

CONCLUSION

Multiple recurring themes describe both the domestic and international construction industry over the last year. Volume of orders is high, but growth is weak. Industrial era projects continue across the globe in support of economic growth generated by 21st century technology. Airports, subways, rapid transit projects, underground interstate connectors, high-rise office buildings, bridges, ports, and business developments tied to these transportation projects are underway worldwide. Challenges include the shortage of skilled labor in special construction trades, scant resources devoted to research and development, and a failure to realize the vast benefits of full implementation of information technology. In spite of these areas, which leave room for tremendous improvements in this sector, the ability of the domestic and international construction industry to mobilize and support future U.S. National Security objectives is sound.

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- ¹ U.S. Industry & Trade Outlook 2000. (Washington, DC: The McGraw-Hill Companies and U.S. Department of Commerce/International Trade Administration, 2000), 6-1.
- ² U.S. Census Bureau, Current Construction Reports, Series C30. 2001, <http://www.census.gov>
- Establishments are defined as a relatively permanent office or other place of business where the usual business activities related to construction are conducted. Establishments do not represent each project or construction site. Includes all establishments that were in business at any time during the year.
- Establishments are based on a survey which included all large employers and a sample of the smaller ones.
- ³ U.S. Census Bureau, Census of Construction. U.S. Department of Commerce, U.S., 1997.
- ⁴ Ibid. Value in 1996 constant dollars=706B\$.
- ⁵ The CERL is the component of the U. S. Army Engineering Research and Development Center tasked with the research and development of new and better construction techniques.
- ⁶ The NFESC is focused on expeditionary functions and Seabees type structures and buildings.
- ⁷ The National Science Foundation funds more than 70 percent of academia's construction R&D efforts.
- ⁸ "A Weak Recovery Won't Lift Nonresidential Construction," Engineering News Record, 18 Nov 02, 40-46.
- ⁹ "The Top 400 Contractors," Engineering News Record, 29 Sep 02, 9.
- ¹⁰ "2002 ENR Top 225 International Contractors," <http://enr.construction.com/people/topLists/topIntlCont/> 19 May 03
- ¹¹ Gary J.Tulacz and Mary B. Powers, "Business and Labor, The Top 400 Contractors: International, Global Political and Business Turmoil Takes a Toll on International Revenue," <http://enr.construction.com/features/bizLabor/archives/030519b.asp>, 19 May 03.
- ¹² Ibid.
- ¹³ The contract requires Halliburton KBR to deploy within 72 hours of notification and to deliver combat support and combat service support for 25,000 troops within 15 days. Halliburton KBR must be ready to furnish these services 24 hours a day, 7 days a week, 365 days a year under any condition and at any location around the globe.
- ¹⁴ FACT SHEET As of May 6, 2003, DoD Mission for Repair and Continuity of Operations Of the Iraqi Oil Infrastructure.
- ¹⁵ Congress authorized privatization in 1996. So far, a dozen contracts totaling 19,374 homes have been let.
- ¹⁶ "Utility Privatization Paper," 19 May 03, <http://www.acq.osd.mil/installation/vision2020forum/issuemapers/Utility%20Privatization%20Issue%20Paper%20Session%202.doc>.
- ¹⁷ "Status of Utility Systems, Current Status as of 4th Quarter, 2002," 19 May 03, <http://www.acq.osd.mil/ie/utilities/status/status4qtrfy02.htm>
- ¹⁸ "Utilities Privatization Progress - Current Status as of 1st Quarter, 2002," 19 May 03, <http://www.acq.osd.mil/ie/utilities/status/status1qtrfy02.htm>
- ¹⁹ Debra K. Rubin and Mary B. Powers, "Industry Firms Develop Niche That is No Longer Secret." A Special Report by ENR and Architectural Record Magazines, 23 September 2002, <http://www.enr.construction.com/features/bizlabor/archives>.
- ²⁰ Carter & Burgess is part of a team comprised of PriceWaterhouseCoopers and Siemens focusing on the aviation market. The team of HDR of Omaha and Westin Engineering Inc. of Sacramento recently won a contract to set up the Water Information Sharing and Analysis Center, which focuses upon water system security. RTKL of Baltimore teamed with various partners to gain experience and expertise with blast security, traffic management, and chemical-biological hazards.
- ²¹ Op. cit. Rubin and Powers.
- ²² Major General Charles Williams, Industry Advisory Panel, 27 Mar. 2003.
- ²³ Given the private ownership of the major firms, no precise numbers are available. Our figure are based on interviews with senior representatives from Bechtel and Parsons and extrapolation from the CERL website, <http://www.cerf.org/about/cab/resource.htm>.
- ²⁴Ibid.
- ²⁵ Based on discussions with Japanese senior executives and site visits.
- ²⁶ While the U.S. construction market suffers from a shortage of skilled labor, some international markets face the burden of key labor shortages exacerbated by weak, non-existent, or unenforced building construction and industry trade training standards.

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- ²⁷ Emily Wax, "New U.S. Embassy Opens in Nairobi," The Washington Post, 4 Mar. 2003, A21.
- ²⁸ Timothy Irwin. et al, "Managing government exposure to private infrastructure risks," The World Bank Research Observer, Washington, Aug 99, V 14, Iss 2, 229.
- ²⁹ Ibid, 230.
- ³⁰ GDS Associates, Inc., Utilities Privatization Issues, April 2003, 2.
- ³¹ Jeffrey A. Renshaw, "Utility Privatization in the Military Services: Issues, Problems, and Potential Solutions," The Air Force Law Review V 53 (2002), 6.
- ³² George Cahling. et al, "Power Play," Government Executive, Jun 02, V 34, Iss 7, 30.
- ³³ GDS Associates, Inc., Utilities Privatization Issues, April 2003, 3.
- ³⁴ "Forecast 2003 – A Weak Recovery Won't Lift Nonresidential Construction," Engineering News Record, 18 November 2003, 40.
- ³⁵ Ibid.
- ³⁶ Ibid, 41-2.
- ³⁷ "Project Financing – Budget is Tough on Construction," Engineering News Record, 10 February 2003, 10.
- ³⁸ Associated General Contractors of America Chief Economist Ken Simonson, "Presentation to the AGC Convention," Honolulu, Hawaii, 21 March 2003.
- ³⁹ Gary J.Tulacz, "In a Slow International Market, Upstream Oil Jobs Fuel Projects," Engineering News-Record, 20 May 2002, <http://www.construction.com/NewsCenter/Headlines/ENR/20020517c.asp>.
- ⁴⁰ "Presentation to ICAF during Industry Studies Tour," April 2003.
- ⁴¹ Op. cit. Tulacz.
- ⁴² Ibid.
- ⁴³ Stephen H. Daniels and Rob McManamy, "Finding a Silver Lining on an Unchartered Path." McGraw Hill Construction, Dec 2001. <http://www.designbuildmag.com/dedc2001/forecast1201.asp>.
- ⁴⁴ Derish M. Wolfe, "Opportunities in the International Field for U.S. Contractors," 2000. Online. <http://www.thebfc.com/Wolff.pdf>.
- ⁴⁵ Op Cit., "Presentation to ICAF during Industries Studies Tour", April 2003.
- ⁴⁶ Society of American Foresters, Tariff Put on Canadian Lumber, 13 August 2001, <http://www.safnet.org/archive/tariff81401.htm>
- ⁴⁷ While our seminar did not arrive at a consensus restructuring approach, possible solutions include allowing inefficient small mills to close and fiscal policies to encourage continued improvement in large mill productivity.
- ⁴⁸ The ability to gain additional revenue per unit of labor added.
- ⁴⁹ Martin Betts, Strategic Management of IT in Construction. (London: Blackwell Science LTD, 1999), 10-11.
- ⁵⁰ A specialty heating ventilation and air conditioning sheet metal firm in the metro area that employs several hundred union workers.
- ⁵¹ Manager-Drafting/Coordination, local sub-contractor, personal interview, 26 March 2003.
- ⁵² Institute of Management and Administration (IOMA), "New Data Show Contractors Are Using More Technology," Contractor's Business Management Report, (October 2002), Online, Internet, www.ioma.com, March 2003.
- ⁵³ Ibid.
- ⁵⁴ Ibid.
- ⁵⁵ "Contractors Turn to Web Services," Engineering News Review, 17 June 2002.
- ⁵⁶ The original goal of 2010 was accelerated in the FY03 budget.
- ⁵⁷ For more information on scoring consult - Randall Howard. "Military Family Housing Privatization," Air Force Comptroller. Vol. 33, No. 1, 1 January 1999, 8-16.
- ⁵⁸ Developing Private Housing for Air Force Families.
http://www.pscmh.com/afceebrochure/developing_private_housing.htm
- ⁵⁹ For the full report see: Michael B. Leahy Jr., "Profit/Subsidy Guidelines for USAF Housing Privatization Projects," Construction Industry Study Paper, Industrial College of the Armed Forces, Washington DC, 2003.
- ⁶⁰ Base housing is occupied by a mixture of ranks – and therefore a mixture of BAH "rents" - that varies for each base location

⁶¹ By definition a condominium is a property in which the space within each unit is individually owned, while the common elements of the property are jointly owned including the building structure and land. Institute of Real Estate Management. Expense Analysis: Condominiums, Cooperatives, and Planned Unit Developments. (Chicago: National Association of Realtors, 2002), 227.

⁶² Institute of Real Estate Management. Expense Analysis: Condominiums, Cooperatives, and Planned Unit Developments. (Chicago: National Association of Realtors, 2002).

⁶³ Institute of Real Estate Management. Income/Expense Analysis: Conventional Apartments. (Chicago: National Association of Realtors, 1998). The 1998 report is the most recent available in the local library system. However an analysis of yearly variations from 1993-97 shows a very slow rate of growth with a total increase of 7.8% of the 5 years. Given the continued low rate of inflation since 1997 we have conservatively adjusted the raw data by 10% for use in our profit/subsidy analysis.

⁶⁴ The spreadsheet also contains the by sq ft data if one chooses to vary the housing unit size for a more refined analysis. 1800 sq ft was assumed to be the median base house for this analysis.

⁶⁵ www.homeenergysaver.lbl.gov.

⁶⁶ The estimates can be customized for the specific house features. For this guide the standard defaults were used.

⁶⁷ Leahy, Table A-2.

⁶⁸ Developing Private Housing for Air Force Families

⁶⁹ E1-E4 BAH rates are equivalent for all bases studied. All rates are from the official 2003 BAH tables.

⁷⁰ Developing Private Housing for Air Force Families

⁷¹ Once again the profit/subsidy electronic spreadsheet provides the flexibility to easily conduct additional analysis based on varying development costs.

⁷² Unless stated otherwise, the original source data for all O&M costs are based on the IREM expense analysis the full set of which is loaded in the master electronic spreadsheet.

⁷³ A detailed breakout of the individual sub-elements of each expense category is shown in Table A-1. Replacement reserve is a savings account for future replacements and capital expenses.

⁷⁴ Leahy, Figure A-2.

⁷⁵ Leahy, Figure A-3.

⁷⁶ Leahy, Figure A-4.

⁷⁷ With a response from 750 projects representing 83,437 units the average number of units per project is only 111. Given the larger size of most base housing projects the private contractors should be able to achieve some additional economies of scale thereby moving toward the lower end of the expense trade space.

⁷⁸ Leahy, Figure A-5.

⁷⁹ There was no specific breakout available for interior maintenance and repair. By IREM definition this category is the cost for (excludes payroll) all general maintenance and repair interior and exterior. Includes exterior painting or cleaning, repair contracts; A/C and boiler repair, plumbing, electrical, plastering, masonry, carpentry, heating, roofing, etc. However most of the items are not listed under condominium expenses so the overlap should be minimal.

⁸⁰ By IREM definition this category includes all contracted labor, materials and supplies used in decorating the interior of the building. Also includes replacement of floor coverings, draperies, furnishings or light fixtures if not a capital expenditure

⁸¹ Again there was no specific breakout available for interior O&M payroll. By IREM definition this category includes janitors, maids, switchboard operators and maintenance people. So there will be some overlap with the condominium expenses, but the bulk of the number is related to O&M.

⁸² Leahy, Figure A-6.

⁸³ Most of the existing housing base was built before 1970 – reference Pamela Twiss and James Martin.

⁸⁴ Leahy, Figure A-7.

⁸⁵ Leahy, Figure A-8 illustrates the variations for the five individual energy categories.

⁸⁶ I strongly advocate holding-back an appropriate amount of energy costs from the rent and allowing the tenants to make their own energy utilization decisions. Without this incentive to control energy costs the contractor and ultimately the government are exposed to unnecessary additional expenses.

⁸⁷ The condominium O&M costs were increased by 5.7% to adjust them forward to 2003. This increase is identical to the increase between the 2001 and 2002 IREM analysis.

⁸⁸ The results for both new and existing housing are illustrated in Leahy Tables A-3 and A-4 respectively.

⁸⁹ Leahy, Figure A-9 illustrates the general trends for a new private housing development with a comparison of average, median, low and high contractor net income over the entire base set.

⁹⁰ Leahy, Figure A-10 illustrates the general trends for an existing housing with a comparison of average, median, low and high contractor net income over the entire base set.

⁹¹ The net operating income percentage is from Institute of Real Estate Management. Income/Expense Analysis: Conventional Apartments (Chicago: National Association of Realtors, 1998).



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